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THE PRESENT STATUS OF THE HISTORY OF SCIENCE IN AMERICAN COLLEGES AND UNIVERSITIES

During the past few years there have been several attempts to establish beyond question the value of a study of the history of science in American colleges. A little has been written in defense of the subject as a proper part of the curriculum, and a few science teachers have spared no effort in the critical study and presentation of the history of the particular phase of science with which they have been most familiar. And yet, the papers that have been written in English dealing at all directly with this history are so few in number that they all may be read in a very few hours. Of histories of science—books relating to the subject matter itself—there are even fewer, so it is not surprising that the otherwise busy teacher has not been drawn into this phase of his science by any sense of an ample amount of readily available material. At the same time, those who have considered the matter seriously have usually become strong advocates of the value of a study of the development of science, both for its service in explaining the present status and aims of science, and also for its value as a picture of human development that probably is not to be equalled in educational value by any survey of political or military movements.

With this conviction, the present writer undertook to ascertain in just how far the history of science was being studied in American colleges and universities. Questionnaires were sent to the deans or presidents of nearly four hundred institutions throughout the United States. While such instruments are necessarily imperfect, and the individual findings perhaps often unreliable, the total mass of material thus gathered together is not without point, and it indicates among other things, that inter-

est in the history of science is far from lacking among American science teachers—that it has, in fact, developed to the point where the majority of them welcome any opportunity to urge a wider study in this field.

In only two or three institutions are conditions such that one man can devote the major portion of his time to the history of science alone, although several of the larger universities seem to be considering the establishing of such a professorship. A more usual method has been that in which a science professor has crowded in with his other courses, one dealing with the rise of his science, or has given a series of supplementary lectures along with a regular course, or perhaps, quite distinct from it. Some teachers have found it impossible to devote time to such work beyond that required for reports or occasional papers on subjects assigned to the students. But all, or nearly all, where there is evidence that they have given the matter serious thought, have agreed that here is a rich field as yet unexplored sufficiently to make clear the best method for its development, but nevertheless one which is full of material as conducive to the understanding and solution of present-day problems as any other.

HISTORY OF GENERAL SCIENCE

Very little has been accomplished by way of giving a course which might properly be called a history of general science. The reasons why such a course is probably well nigh impossible are not difficult to find. Yet, in one institution—small enough so that one man teaches the several sciences there offered —this instructor believes that he has been successful in giving a history of natural science as a whole. Such an experiment is interesting, but it should not be misinterpreted. The very fact that all of the science courses offered are necessarily more or less introductory, means that only the growth of the simpler developments can be reviewed with intelligence, and the limitation of time reduces the work to a series of excursions into the several recognized divisions of natural science. In the words of one who is himself one of the best-known American historians of certain limited phases of scientific endeavor,

> No one instructor can give a course worth giving on the History of General Science!

A somewhat better procedure—and one that will be discussed more later—is that in which by means of the collaboration of instructors in each of several sciences, it has been possible to organize a regular course or a series of extra-curriculum lectures touching ably the several branches represented. This method has the weakness of presenting the subject matter disconnectedly, and what the majority of the listeners gain will be in inverse proportion to the extent of the survey attempted. If only a very tiny bit of the lore in a given science is examined, it may be productive of some permanent mental impression. Such glimpses at several of the brighter spots in the history of the various divisions of science do not in any true sense constitute a history of science as a whole, or in parts that may be closely related. But that this method recommends itself is proven by the fact that it has been tried out several times and one of our largest universities is now considering the establishment of such a course.

Some of the colleges are offering what they designate as a history of general science, with the announced intention of making it purely introductory to a more intense study of special sciences. This practise, however, is not in accord with the general feeling of science teachers. The majority of them state frankly that they regard a knowledge of the fundamental principles of a science as absolutely prerequisite to any intelligent study of its growth. Where the rise of science is considered in a general way by the department of philosophy, it would naturally come late in the college course, and hence could scarcely serve as introductory to other undergraduate studies.

One or two colleges offer courses on the history of science extending through one semester only. Apparently this work is open to any one seeking a brief diversion from the things of the present, and while it is surely

of some value—presumably more to the instructor as the nucleus of future courses of the same type, than to the student—it must quite necessarily be regarded as one of the excursions referred to above.

Another institution gives a lecture course —one lecture a week—under the title of "Science and Scientists." This is open to freshmen and sophomores in Arts and Business Administration. It undoubtedly serves to show these young people that there have been great factors in human development other than those in which they are specializing—but it, too, is hardly of sufficient scope to be classified as a history of science.

In colleges where special attention is given to the preparation of science teachers, it has been natural to introduce into the regular courses of a more or less pedagogical nature quite a bit of historical material. And this is as it should be, for the students here in attendance are presumably somewhat familiar with the science they intend to teach, and can derive the maximum benefit from whatever historical glimpses they may be offered. If they have a real love for their subject they will fill in many of the gaps with their future reading and thus gradually acquire a measure of the historical sense in no way to be despised as a part of their scientific background.

There are a number of methods by which historical investigation and instruction may be carried into the general field of science. All have been tried with more than tolerable success. At present we can only refer to them sufficiently to indicate their approximate natures.

First, there is the public lecture course given by men belonging in the institution, or brought in for the occasion. These lectures may be in the form of a number of intimate views of a period, of the development of the science of a certain people, of the growth of a definite line of science, or each in itself may be quite complete, and otherwise wholly disconnected from the others. Whatever the form actually employed, where the speakers know their subjects, make all possible use of modern forms of illustration —lantern slides, charts, models, maps, etc.— the impressions gained by the listeners can not be other than lasting and altogether beneficial.

Where only a small amount of time can be given to the lectures each week, it is possible to carry the course through more than one year and thus cover the ground quite comprehensively. But such an arrangement usually means that attendance is optional, and without great effort it would be difficult to keep up such an interest and receptive state of mind as might obtain at the occasional lecture.

For a long time the seminar method of delving into the history of a science has been familiar. Where weekly departmental meetings are open to all who are sufficiently trained and interested to make their attendance profitable, the atmosphere of the gathering may engender real enthusiasm. It may result in an almost religious feeling towards one's beloved science, and hence, is a form of education which should be encouraged and maintained regardless of more systematic courses which may profess to cover the same ground. Subjects studied in course can not acquire the quality obtainable in the close communion of a few who have been drawn together because of a common interest in the subjects themselves, quite apart from the idea of payment in the form of credits towards graduation.

Closely connected with this sort of organization are the societies or clubs. These may range from the very elementary undergraduate groups to the postgraduate societies with or without affiliations extending to other institutions. One of the best examples of what a scientific society may accomplish was afforded recently by the Yale Chapter of the Gamma Alpha Graduate Scientific Faternity, under whose auspices a series of lectures was given. Each speaker was a leader in his line, and each covered in a brief but quite comprehensive way the historical growth of his own branch of science. Thus there were delivered, and later printed, admirable sur-

veys in the fields of mathematics, chemistry, biology, psychology, physics, geology and astronomy. Naturally, these were not of a type suitable for elementary presentation.

One institution—a college of engineering—gives a two-hour course on the history of science to all sophomores. In another, two courses have apparently gradually merged into one. For many years a course dealing with the history of the inductive sciences had been offered by the professor of biology. Later he was joined by the professor of mathematics, and between them they rounded out the course into a fair approximation of a general history of science, or more correctly, a brief history of several associated branches of science. The usual limitation of time made it impossible for them to cover everything, and so, *e.g.*, the history of chemistry was handled independently by the professor in that department. The lecture notes of the two men thus associated finally reached such proportions that they were printed, and now form a well-known elementary text on the subject. According to one of the authors, the real object in putting the material into book form was to lessen the dependence of the students on the lectures. As originally worked out, the time was divided about equally between the two instructors, the mathematician covering most of the Greek period, and mathematical science previous to the calculus of Newton. The biologist has traced the development of modern science and the special phases of the entire review with which he was most familiar. Each student is supplied with blank forms for his reports on collateral reading of biographies and other historical subjects in connection with the course. Essays are required, for it has been the feeling of the instructors that nothing short of this written work secures a sufficiently intensive study of the assigned reading matter. The two parts of the course may be taken independently, and although the work has been elementary enough to make no definite prescription of preliminary scientific work necessary, it has quite naturally been found that "some degree of scientific background and some maturity are desirable."

This method of procedure has been discussed here somewhat in detail because it shows very admirably what may be accomplished by pioneers. However inadequate such courses may seem, they are of the type that may be organized in almost any college if there is but time. The form of cooperation will depend on the men and material available.

A well-known college for women has found some value to be obtainable in a collateral reading course which is carried on privately throughout two years. In still another college, the cooperative method referred to above has proven quite successful. Apparently, the department of philosophy gives two lectures a week on "Life Views of Great Men of Science." At first this would seem like a rather large responsibility for such a department to assume, but the college catalogue shows that associated with the instructors in philosophy—one of whom is the president of the institution—are men from the departments of astronomy, geology, chemistry, mathematics, physics, anatomy, physiology, zoology, economics and sociology. Such wide cooperation, while not free from some of the objections made above, is most gratifying and must make not only for good feeling between the several departments, but serve the students as material evidence that each so-called science is only one phase of a great body of truth—that its various developments are all aspects of one growth.

In one of the greater universities, two associated courses are given, one a "History of Science from the Physical Standpoint," and the other, a "History of Science from the Biological Standpoint." The lecturer in each case occupies a prominent place in his chosen field. Undoubtedly, these courses are primarily historical reviews of physics and of biology, respectively, and should be classed with the rather narrow histories of specific sciences to be considered later.

In another university there has for some time been given a composite course dealing

with biology and physics. The lecturer himself is a physiological chemist, and would be expected to take the experimental viewpoint. Such a combination of these subjects is quite natural when one considers the parallel steps in their development. For example, how closely were they connected in the early work of the Royal Society, and how evidently is the apparatus of modern biology borrowed from the physical laboratory! In this same institution a special lecturer has dealt with specific phases of the history of science, and also written much, advocating its wider study. His method seems to be that of following the growth of an idea and the philosophy involved. Both methods of approach are proper and will undoubtedly leave their separate imprints on the later forms in which the history of science will be handled.

One further arrangement for approaching this subject in a general way may be mentioned, although the course referred to is not offered primarily as a history of science. At a certain college a general culture course has recently been organized under the all-embracing title of "Evolution." The fact that it is given by the department of biology might lead one to expect the usual restricted meaning of the term. However, in the words of one of the instructors responsible for its direction,

> It is a composite course that covers so wide a field that the bare facts are emphasized rather than historical development, although the latter is by no means ignored. Fundamental chemical and physical principles are given without any historical setting, but the lectures on astronomy necessarily take up the historical side, especially in the development of evolutionary theories. The same may be said for the biological lectures where we cut out all possible detail yet give a skeleton outline of the contributions of the more celebrated men to the theories of organic evolution. The course ends with a review of the present known facts regarding the organic development of man himself while a certain amount of time is given to social and mental growth (culture).

As this course itself is still in the early stages of its evolution, its real value can not as yet be ascertained, but it is not impossible that it, too, may serve as one of the pioneer attempts that will form the basis for the future courses on the history of science.

HISTORY OF SPECIFIC SCIENCES

There are many evidences that much more success has been obtained in the shaping and conducting of courses on the history of the specific sciences than where the whole field of science has been engaged in a single campaign. Here the difficulties to be met by the lecturer in crossing the boundary between two branches of science are largely avoided, and although the interrelation of the several sciences can not be lost sight of, his natural limitations do not prevent him from presenting the history of his specialty in a manner that is sufficiently connected to lead to logical conclusions. He is able—by limiting his attention to a single field of development—to secure a picture so complete as to impress the student's mind with the one fact of paramount importance, namely, that he is reviewing a growth, one that never goes backward, and one which in its latest stage—the present—is an integral part of the world as he now sees it. Such a study, to be of greatest worth, is, of course, suitable for advanced students only in the particular science to which it relates. Here is an unquestionable case in which the advocates of prerequisite scientific training are thoroughly sound. The field is not new. Enough has been written to make great blunders no longer unavoidable, and many such courses are at present being offered in American colleges, though so far their usefulness has been limited by the lack of time on the part of the teachers and the failure of others to appreciate the value in such things in this age of seeking after immediate practical results.

Naturally, mathematics is one of the leading subjects whose history is now being taught as an independent course. The maturer the student and the wider his knowledge of the methods of mathematics, the greater will be his pleasure and benefit from a review of the philosophy and labors that have developed the powerful mathematics of the present. In some institutions it has been possible to combine something

of the history of mathematics with a course on the methods of teaching mathematics. Then, too, there are the usual variations—special lectures in connection with or supplementary to the regular mathematical courses, seminar work, etc. Closely associated with historical studies in pure mathematics are those, such as the histories of astronomy, civil engineering, analytical mechanics, and mathematical physics.

Where the history of a special science is handled by a member of the department of instruction devoted to that science alone, the viewpoint of the scientist, *i.e.*, the viewpoint of the original investigator and discoverer whose work is being studied, may be presented. The physical equipment within the department affords not only a convenient but absolutely essential means of illustration. In many cases, this may and should involve the actual repetition, step by step, of the classical experiment or investigation. All possible pertinent material should be acquired for its usefulness in this particular course, and that this can be handled to the best advantage only by the specialist, goes without saying.

At present there are offered in this country courses dealing solely with the histories of mathematics, physics, chemistry, biology, zoology, botany, evolution, anthropology, astronomy, geology, psychology, medicine, pharmacy, home economics, engineering, and probably many others. In some cases there are evidences that these subjects have been offered because of the vision of a single man who not only launched the work, but maintained it personally. That this has often been so is shown by the fact that the course has been allowed to lapse after the departure of this particular teacher. Those who remain are kept too busy to carry on the work, although the majority of them have expressed the firmest conviction of its worth.

The historical courses in these main divisions of science are modeled differently in various institutions. A few attempt to cover the entire history of the subject chronologically. In other cases the material is taken up by periods, *e.g.*, the "Development of Chemistry During the Seventeenth Century." Or again, a very narrow line of growth within the science may constitute the subject matter of the course, such as the "History of the Law of Gravity." Either of these latter methods, though limited in scope, makes possible quite thorough work.

The present high development of the sciences is a thing of such modern times that there is no end of material available for studying the recent portions of their growth. Here again is a task that must be directed by the specialist—one who is familiar with the literature of his science. Probably no physicist would consider himself capable of directing the historical reading and research in the field of botany. Likewise each science teacher would view as puerile the attempts of any one—no matter how capable in a special field—to direct all of the various phases in a course on the history of general science.

From time to time eminent chemistry teachers have conducted lecture courses on the chemistry of a period or the evolution of a chemical theory, although in many cases such instruction is no longer given. Probably this is because the present-day specialist finds little time for such studies in addition to the purely technical work for which he is most admired just at present.

One institution gives each beginning class in chemistry five lectures dealing solely with historical matter. Of course, in all schools some of the history of the subject is introduced from time to time in the regular instruction in the science. Some teachers of long experience have expressed themselves as greatly in favor of giving more time to this history—a special course, if possible—but owing to the difficulty in setting apart the requisite amount of time for such a thorough study, they have had to content themselves with mere references to the historical background. However, this method in any science is not without its good points, for it is one of the surest ways of securing interest, and at the same time it prevents the student from grasping a law or serviceable result as a God-given tool and the only feature worth retaining. It shows him the essentially hu-

man quality that lies under and behind all progress—that all progress is at the expense of human endeavor. And is not this one of the prime objects of education?

The history of physics is only beginning to be fully appreciated. In one of the eastern universities, courses were conducted for a time by the head of the physics department, in which he sought to present "not only the material that can be found in some of the books upon the subject, but also traced the development of certain fundamental fields." He employed the lecture method. His success and possibly the reason why the work was not continued after his departure from the institution, are explained in part by the remark of one of his colleagues.

> Professor ——— himself was able to add the personal touch of experience in the historical development in many phases of the work in physics.

This, of course, is a brief statement of the ideal qualifications of the director of any course in the history of science.

Often brief courses on special historical subjects, or rapid surveys of a large portion of the growth of a science are opened to prospective teachers. Such work—where the students are well grounded in their subject and where the widest possible use is made of the departmental library—is probably of no small value, if for no other reason than that by enriching the coming teacher's outlook, it will make better the instruction of the next generation.

Where time is limited, a course may be offered, say, once in three years, or the departmental society or club may be pushed into really serious activity. Even extension courses are worth while if the students are themselves teaching and have some library and laboratory facilities at their own disposal. Such work may be closely allied with regular graduate work in the same field.

A suggestion as to how a course may be composed of biographical studies, as well as of a review of purely technical developments, may be gained from the statement that the study of the history of botany in one of the greater universities has "included not only the evolution of the science, but the lives and contributions of leading botanists, the history of the microscope, etc."

METHOD OF PRESENTATION

The formation of a course in the history of any branch of science has, in the majority of cases, waited for the appearance of some sort of book that might serve as a text. Few instructors have had the time or the courage to plunge into such a course dependent only on their own lecture material and the assignments of collateral reading. No matter how desirable it may be that the teacher should be thoroughly capable of writing his own text, energy and opportunity are seldom available for such an accomplishment.

Almost with one accord, the teachers who have responded to the present inquiry have voiced this need for text-books, for there is very little in English that may be so used. Note that the cry is not because of a lack of original source material for reference or research work, but for suitable secondary sources that present the material in a form sufficiently well chosen and digested to be usable by the beginner and constitute a skeleton about which a course may be built up. This seems to be true even in the cases of those sciences of which one or two quite admirable histories are now available. In addition, little is to be found in book form covering the developments of the last decade or so. Of the few history texts available, there is almost no choice. They are necessarily the same works as used elsewhere and in former courses. For obvious reasons they can not be listed here, but their number is so small that every science teacher probably has on his own desk all that is obtainable for his use at the present time.

These few books are usually the outgrowths of lectures given when there were no texts at all. The years that have elapsed since their publication have put them out of touch with modern advances, although this is a fault which may usually be overcome by the use of references to current literature during the latter days of the courses in which they are used. It is perhaps not surprising that teachers have

been quite harsh in their criticisms, but it is to be hoped that their distress is sufficiently real to drive them to the point of writing something better, for here is one of the few fields in which there are not too many books.

Where a course has been limited to the study of the growth of a theory or of a particular branch of the science, some useful books have usually been available. Single works dealing with the progress of a given era are much scarcer, and, as already suggested, satisfactory works covering the entire growth of the subject are rare indeed. The natural compromise that has resulted is a combination of the lecture and text-book method. To date this form seems to have had the widest trial. Instead of depending upon one book only, the library facilities may be drawn on so as to make use of many authors in addition to the lecture notes. Papers on these outside readings insure a fair degree of application in their use. One teacher employs the lecture method mainly and assigns to the students biographical topics only. In another institution, where several courses in the history of science are given, a text-book in one of them serves as the nucleus about which the course centers, but the class discussion is devoted mainly to points in a set of over four hundred typewritten questions supplied by the instructor. There are also reports on outside reading. In the psychology classes, finding no book suitable, the lecture method has been employed almost entirely. The same is true in the history of pharmacy, but also for the additional reason that at the time of the report the class had over one hundred and twenty members. In medicine, at this institution, the lecture method is supplemented by an assigned paper on a historical subject to be chosen by the student himself.

In connection with this question of the form of presentation of the subject, it is interesting to note the method employed by one instructor in chemistry. He wrote:

> I let the class decide which style they prefer. If they are preparing to teach chemistry, they seem to prefer a text-book, otherwise they choose the lectures.

He says nothing about any difficulty in getting the members of the class to agree.

Another method, and when it can be carried out consistently, the one most in keeping with the fact that any historical study should be an attempt to see for one's self as clearly as possible just what has transpired, and what were the immediate causes contributory to the various progressive steps in the growth of the science, is that where the lecture method is combined with the reading of original sources. Many a small college library contains much material that may be used in this manner, *e.g.*, the *Philosophical Transactions*, and the scientific journals that have been published during the past century. Reprints of older sources are now available on quite a number of subjects, and fragments of original papers are often to be found in encyclopædia articles and elsewhere, so that with diligent searching the instructor will usually be able to make a beginning, and he may be surprised at the wealth of material close at hand.

The type of material obtainable from current periodicals is too familiar to need discussion here. *The Readers' Guide* will indicate the main papers of the essay type which may be found in popular magazines and which are serviceable in a course on the history of science. Where complete files of the older technical journals are available, they will naturally be put to almost constant use, although in one institution now offering such a course it is declared that there are "none used." In another, the instructor in the history of chemistry refers his pupils to "the best known chemical journals, especially for their obituary notices." Undoubtedly still other features of interest may be found.

Where the students are sufficiently advanced and equipped to handle foreign languages, their investigations are greatly facilitated, for aside from possibly a single periodical in English dealing exclusively with the history of science, there are several of this type in Europe.

One question that arises quite naturally in the projection of a course on the history of science, is whether it shall be of the "cul-

tural" type and perhaps open to the majority of students, or of the sort suitable only for those who have already begun specialization. These are, of course, quite different propositions, but the consensus of opinion is that the latter type—where the student has at least had a fair introduction to the subject—is the one capable of the greatest good. In one instance, a historical study of chemistry and zoology is regarded as a "general cultural course offered to all students who have the scientific background which would enable them to carry the work intelligently." Another institution opens its course on the history of chemistry to all students, "but prerequisites are insisted upon." Some schools simply require that applicants shall have had one full year in the science. Others allow any students within the institution to attempt the work if they wish to, but insist that it be taken by all who are majoring in the department. A geology instructor says that "good training in geology is prerequisite to history of geology"—a requirement which is not very definite. Though one teacher—a chemist—considers his history a purely cultural course, he admits only those who have had some work in organic chemistry in addition to the general courses. Another instructor has a different vision. He hopes that the course which is now open only to students working in his department, will ultimately become a cultural one and open to everyone. At one college giving a history course it is claimed that "the lecturer has maintained a certain standard by assuring himself that each student has taken courses in the biological as well as the physical sciences." The department of chemistry in one of the western universities is in a position to offer a strong course on the history of science from the fact that it admits to this class only "graduate and upper class students in chemistry with extensive prerequisites, including French, German, advanced mathematics, and physics—general courses."

These brief references show that in many institutions it is now possible for those students who are specializing to obtain courses on the history of their subject.

PUBLICATIONS BY PRESENT TEACHERS OF THE HISTORY OF SCIENCE

The administrators to whom the present inquiry was directed were asked to supply lists of the papers and books dealing in any way with the history of science and written by members of their instructional staffs. The results obtained are probably in no way a fair indication of what has been accomplished, for aside from the few well-known books already referred to, apparently only a little has been done, even including thesis work, popular biographical sketches, bibliographies, and unpublished papers which have been read before local or possibly state scientific societies.

CONCLUSION

It has been a pleasure to read the comments and suggestions of those who have so generously assisted in the present inquiry. Many of these ideas have been embodied in earlier parts of this paper. By far the majority of the letters received are strongly in favor of pushing the history of science to the position of a regular feature of the curriculum. In some schools the faculty is too small to add any subject whatever to the course of study. In such institutions, it is not unusual that the mathematics professor would be glad to offer a course on the history of mathematics. A physics teacher "would like to see such a course in physics offered, but lack of time makes it impossible at present." In spite of the historical material which every science lecturer now and then introduces into his courses, one of them writes: "most of our students know very little about the history of science. Much more attention should be given to this subject." A professor of chemistry thinks "it very advisable to give a short history of the development of chemistry. Will do it when it can be squeezed in." This indicates the general difficulty.

A college dean, as if sensible of inexcusable negligence, hastens to remark:

We realize the value of this subject as an integral part of a progressive curriculum and we shall in due time organize such a course.

Similar expressions are too numerous to quote here.

A need for such a course is arising.

Of great importance!

I am glad to see interest in this important subject is developing widely.

There is without doubt a place for such courses. . . . I should like to see here and elsewhere a "general cultural" course in these subjects offered. This would be of vast interest to B.A. students who would not be attracted by the more thoroughly scientific courses. (The word "scientific" is probably used here to mean "technical.")

The president of a certain engineering school would not favor any deviation from a rigorous technical presentation of the subject, for he believes "that all subjects are cultural if properly taught and so placed before the students." An eminent chemist has the satisfaction of feeling that his history lectures are "proving helpful to prospective chemistry teachers."

A physics instructor in a prominent university writes:

The history of science, either in its general aspect or in specific fields, is an interesting and valuable part of science training, but it is extremely important that the presentation of such work be such as will arouse interest and give the perspective that will enable the student of science to better understand the order in which facts and theories have developed. Such an understanding of the past will help the student in getting a clear idea of exactly where the boundary line between experimental fact and theory lies. I feel that this vitalizing purpose is essential to the success of such work.

A number of administrators have written that the matter of establishing one or more courses in the history of science is already under discussion. Where the idea is new, a few have questioned the possibility or appropriateness of such a course, but the wide success elsewhere serves amply to answer such objections. For example, a leading university president has expressed some of the difficulties of the situation with remarkable comprehensiveness, and were it not for this fact that very successful arrangements have been developed on a number of lines throughout the country, his statement of the problem would be quite discouraging. It is, however, worthy of attention.

Two distinct types of courses are possible, and appeal to two distinct groups of students: (1) General courses requiring but a moderate amount of technical knowledge on the part of either instructor or students. (2) More specialized courses given by experts in single branches of science for students who are somewhat acquainted with the science in question. No combination of the two types seems to me possible. Even if a sufficiently polymathic instructor could be found, no group of unspecialized students could follow him, and no group even of specialized students outside their own specialties.

A joint course by the representatives of the several different sciences could, of course, be organized, but could not go far without getting away from the class.

The problem is a hard one.

And yet, like other hard problems, it is meeting with partial solution in many quarters.

In this investigation the data obtained can not be thrown into the form of definite numerical values, for several quite evident reasons. The questionnaire method of gaining information has its own natural weaknesses. All who answer are more or less prejudiced. Some may show an interest that is by no means real, or they may give the answer that they believe will sound best as coming from their institution. Furthermore, no weight has been assigned to the courses considered in terms of the number of semester-hours covered. The size of an institution is not taken into account, nor the number of instructors and students in the science departments. Sometimes deans or presidents have answered questions in a general way that could be handled better by the men in science, and one science instructor has usually replied for all of the science departments. Hence, the replies have not always been as representative as could be desired. Departments given over entirely to experimental

research and instruction naturally have not developed courses from the historical side, although the individual instructors may be quite well versed in the subject. Then again, the answers received indicate that even among these men the distinction between so-called "popular" science and fundamental science is by no means clear.

Lest offence be taken by teachers of political and social history, it should be emphasized that no consideration has been given here to their admirable work in tracing the development of human thought and of their growing appreciation of the influence of scientific progress on all history. Their cooperation is needed at every turn—in developing the special methods of historical research suitable for scientific work—in creating a greater demand for such history, and in producing the literature which may satisfy the new needs.

The various suggestions here made are given for what they are worth. Few points of procedure have been indicated as wholly preferable. They are all the testimony of the men and women whose vision has led them into the struggle to add this true side of history—and of science—to those already in the schools, for it is human history, as well as history of science.

My sincere thanks are extended to all who have submitted their views on any phases of this question. Certain aspects of the investigation will constitute material for reports elsewhere.

E. H. Johnson

Kenyon College,
Gambier, Ohio

THE EXPEDITION TO TRINIDAD FOR THE STUDY OF HOOKWORM DISEASE [1]

An expedition for the study of the life of hookworm eggs and larvæ in the soil was sent out by the department of medical zoology of the School of Hygiene and Public Health of the Johns Hopkins University to carry on investigations in Trinidad, British West Indies, during the summer of 1921. The expenses of the expedition were paid by the International Health Board of the Rockefeller Foundation. The International Health Board through the Trinidad Ankylostomiasis Commission and the Trinidad government cooperated with work of the expedition. The party from the United States sailed from New York on May 5 and returned on September 17. The expedition was under the direction of Dr. William W. Cort of Johns Hopkins University, and worked in cooperation with Dr. George C. Payne, the director for Trinidad of the International Health Board, who also took an active part in the investigations. The others who took part in the investigations were Dr. James E. Ackert, of the Kansas State Agricultural College, Dr. Florence King Payne, of Trinidad, and Mr. Donald L. Augustine, of Johns Hopkins University. Much of the scientific equipment was shipped from the United States and some was borrowed from the Trinidad Ankylostomiasis Commission. The work was carried out at Princes Town, which is in the south central part of the island, in an area where sugar-cane cultivation predominates. Over seventy per cent. of the people of this region are infested with hookworms. This high incidence of hookworm disease and the close coordination with the control campaign served to suggest problems for work and to give an abundance of material. A private residence was rented for a laboratory and fitted out with the necessary equipment. A large space under this house was utilized for animal pens and laboratory space. The yard surrounding the house was also used in a number of the outdoor experiments.

The investigations of the Trinidad expedition were centered around the study of the phase of the life of the hookworm which is passed outside the human body. An effective attack on the problems of the life of the larvæ in the soil was made possible by the utilization of an apparatus invented by Baermann, which makes it possible to iso-

[1] A full account of the results of the work of this expedition will appear in a series of articles in the *American Journal of Hygiene.*

late the larvæ from considerable quantities of soil. Both field and laboratory studies were included in the program. The field investigations consisted of intensive epidemiologic studies of the factors involved in the spread of hookworm disease in two limited areas, one on a sugar estate and the other on a cacao estate. The laboratory investigations included a study of the following points, viz.: (1) the relation of the chicken and pig to the spread of hookworm disease, (2) some of the factors influencing the hatching of the eggs, (3) the migrations both vertical and lateral of the infective hookworm larvæ and (4) the length of life of the infective hookworm larvæ.

A summary of the most important results obtained will be given here.[2]

1. SOURCES OF HUMAN INFESTATION

In the two field areas studied a comparison of the distribution of soil infestation and the habits of the people revealed that almost the exclusive sources of human infestation in these two areas were the places in a cane field and a cacao grove which were constantly visited for the purpose of defecation.

2. REDUCTION OF SOIL POLLUTION BY THE INTRODUCTION OF LATRINES AND AN EDUCATIONAL CAMPAIGN

It was found by a study of the distribution of soil pollution in the cane area that the building of an adequate number of latrines and the carrying through of the regular educational campaign against hookworm disease resulted in a very great reduction of soil pollution in a period of about three weeks.

3. RELATION BETWEEN THE DISTRIBUTION OF SOIL POLLUTION AND SOIL INFESTATION

In both the cane and cacao areas gross soil pollution by infested individuals did not always produce soil infestation, especially in unprotected places near houses, latrines or at the edge of the cane field. The conclusion was drawn that in the heavy clay loam soil of these areas the conditions are unfavorable for the development or continued life of the hookworm larvæ, unless there is protection by shade and vegetation.

4. THE RELATION OF CHICKENS TO THE SPREAD OF HOOKWORM DISEASE

When chickens ingested human feces containing hookworm eggs only a very small percentage of such eggs produced infective hookworm larvæ. Chickens fed on human feces containing hookworm eggs were found to produce limited areas of soil infestation at their drinking places, or under their roosts. The conclusion is drawn, however, that in view of the great reduction of infective larvæ produced by passage through the chickens, they are, under the conditions in Trinidad, a factor favorable rather than unfavorable to hookworm control.

5. THE RELATION OF THE PIG TO THE SPREAD OF HOOKWORM LARVÆ

Eggs of the human hookworm which had passed through the digestive tract of the pig developed as readily in pig as in human feces, thus making pigs a factor in the dissemination of hookworm larvæ whenever they have the opportunity of ingesting human feces containing hookworm eggs. In connection with this work a new species of *Necator* closely resembling *Necator americanus* was found to be prevalent in the pigs in Trinidad, and its morphology and distribution studied.

[2] These results are taken from the work of all the members of the expedition. The epidemiologic studies in the field were made by Doctors Cort and G. C. Payne. The work on the relations of the chickens and pigs to the spread of hookworm disease and on the conditions influencing the hatching of hookworm eggs was done by Dr. Ackert. Drs. Florence K. Payne and Ackert collaborated on the work on the new species of pig hookworm from Trinidad, and Dr. Florence K. Payne made the studies on vertical migrations of the infective hookworm larvæ. The laboratory experiments on the horizontal migrations and length of life of the infective hookworm larvæ were made by Mr. Augustine.

6. CONDITIONS INFLUENCING THE HATCHING OF HOOKWORM EGGS

Hookworm eggs hatch as readily in ashes as in soil. Hookworm eggs in feces buried to a depth of from 1/2 of an inch to 2 inches hatch and the larvæ develop in numbers, there being only a slight retardation in development. When eggs were buried from 4 to 5 1/2 inches in a clay loam soil, only a few larvæ were able to develop. The invasion of the stools by numbers of fly larvæ was found to be detrimental to the development of hookworm larvæ to the infective stage.

7. THE FINDING OF UNSHEATHED HOOKWORM LARVÆ IN THE SOIL

The finding, both in field and laboratory studies, of a large percentage of mature hookworm larvæ without their protective sheaths, led to the conclusion that a large proportion of such larvæ in the soil complete their second larval moult and continue to live in the unsheathed condition.

8. VERTICAL MIGRATIONS OF INFECTIVE HOOKWORM LARVÆ

It was found that under certain conditions mature hookworm larvæ when buried to a depth as great as 5 1/2 inches can migrate to the surface. In such a migration the larvæ used up most of their reserve food supply, so that after reaching the surface they were relatively inactive and the cells of the intestine had become almost transparent.

9. HORIZONTAL MIGRATIONS OF INFECTIVE HOOKWORM LARVÆ

From laboratory experiments and field observations it was found that mature hookworm larvæ do not migrate actively from their place of development, although they may be carried to considerable distances by the action of water or on the feet of man. These observations showed that the present idea that the soil of considerable areas can be infested by the migrations of the larvæ from limited centers is untenable.

10. LENGTH OF LIFE OF INFECTIVE HOOKWORM LARVÆ IN THE SOIL

Under the conditions in Trinidad the length of life of infective hookworm larvæ in the soil is short, almost never exceeding six or seven weeks. In an area of a cane field where there was intense soil infestation there was a reduction of over 90 per cent. in the numbers of larvæ in about three weeks after the practical elimination of soil pollution. After six weeks only a very few larvæ were left. In a large series of laboratory experiments carried out with different soils and under different conditions, there was a great reduction in numbers of larvæ after from two to three weeks and an almost complete dying out in six weeks. These findings which are contrary to the present conception of the length of life of infective hookworm larvæ indicate that under tropical conditions, the larvæ will die out quickly in the soil after the elimination of soil pollution by infested individuals.

WILLIAM W. CORT

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, MD.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: THE TORONTO MEETING

THE second Toronto meeting of the American Association and associated societies will be very conveniently arranged in all its details and promises to be one of the most satisfactory meetings in the history of the Association. The preliminary announcement of the meeting has recently been sent from the Washington office to all members, and the permanent secretary will send copies to all who request them.

The announcement, a 47-page booklet, gives the personnel of the local committee for the meeting (Dr. J. C. Fields, chairman; 198 College St., Toronto) and the list of the chairmen of the twelve subcommittees that have charge of local details, also the list of the Toronto representatives of the various sections. Many features of the meeting are mentioned or described. The usual lists of

officers and committees are included, together with a complete list of the associated societies.

Its international character will be an important feature of this meeting; it is not often that the association meets outside of the United States.

As has been announced in SCIENCE, railway rates of a fare and a half for the round trop (on the certificate plan) will be available to those attending. The announcement gives detailed instructions for securing these reduced rates. Every one going to the meeting should secure a certificate when he purchases his going ticket, even though he does not wish to take advantage of the special fares, and all holders of certificates (or round-trip tickets from the far west, outside of the region of reduced rates) should record them at the registration room immediately upon arrival. To secure the privilege of lower fares there must be at least 350 certificates and round-trip tickets (counted together).

The Toronto meeting will be especially convenient and otherwise enjoyable by reason of the special lodging and dining arrangements that have been made by the local committee and its subcommittees. Those in attendance are to be housed in the dormitories of the University of Toronto, and meals will be served in the university dining halls. The meeting places of the sections and societies will be in the university buildings, and only a short walk will be necessary to reach them from the dormitories and dining halls. A uniform rate of $3 a day will be charged, including meals. The announcement contains the usual table showing hotel rates, but those attending the meeting are urged to take advantage of the rooms and meals provided at the university. To engage rooms, address Professor J. M. D. Olmstead, chairman of the subcommittee on dormitories, 198 College St., Toronto.

There will be an exhibition of scientific apparatus and products. Those wishing to exhibit should address Professor E. F. Burton, chairman of the Subcommittee of Exhibits, 198 College St., Toronto.

The publicity arrangements for the Toronto meeting promise to be exceptionally good. This work is in charge of the Subcommittee on Publicity, with the cooperation of Science Service, of Washington, D. C. Material for newspaper publication, or abstracts, etc., that may be used as a basis for newspaper notes, should be sent until December 24, to Dr. E. E. Slosson, editor of Science Service, 1701 Massachusetts Avenue, Washington, D. C. After the date just mentioned they should be sent to Professor A. G. Huntsman, chairman of the subcommittee on publicity, 198 College St., Toronto,—or handed in at the publicity office near the registration room. Those planning to give papers or addresses at the meeting are urged to send accounts to Dr. Slosson in advance.

An exhibit of educational motion pictures on scientific subjects is arranged for Tuesday afternoon, December 27, the pictures being furnished by the Visual Education Association.

The meeting will open on Tuesday evening, under the presidency of Professor E. H. Moore, of the University of Chicago. At this time the retiring president, Dr. L. O. Howard, of the U. S. Department of Agriculture, will give his presidential address. A reception will follow the opening session.

On Wednesday afternoon, December 28, there will be a reception in the Royal Ontario Museum.

The Wednesday evening session will be occupied by a lecture given by Professor William Bateson, director of the John Innes Horticultural Institution, Merton Park, Surrey, England. This eminent British scientist is to attend the Toronto meeting under the joint auspices of the American Association and the American Society of Zoologists.

On Thursday afternoon, December 29, Sir Adam Beck, chairman of the hydro-electric commission of Ontario, will deliver a lecture, with motion pictures, on hydro-electric developments in Ontario.

Thursday evening will be devoted to a

general conversazione in Hart House, to which all members of the association and associated societies are invited. Many of the athletic activities of Hart House may be seen, such as boxing, diving, water polo and indoor base-ball. There will be band music and bag-pipe music, and a concert in the music room. A program will be staged in the Hart House theater. Refreshments will be served in the Great Dining Hall of Hart House. Hart House will be open to visitors also on the evenings of Tuesday, Wednesday and Friday.

An exhibit of artistic skating by the Toronto Skating Club, followed by an ice-hockey match, will be given, under cover, on Friday afternoon. All in attendance at the meeting are invited.

The general program of the Toronto meeting, including programs for the sections and for the twenty-one associated societies meeting with the association at Toronto, will be ready for distribution on Tuesday, December 27, at the registration room.

Burton E. Livingston,
Permanent Secretary

SCIENTIFIC EVENTS

FOREST EXPERIMENT STATIONS

A recent circular by the Forest Service of the Department of Agriculture, entitled "Forest Experiment Stations," outlines what forest experiment stations have done, what they need to do, why they are needed, where they are needed, and what they would cost.

Six stations were established in the West between 1908 and 1913, with a small technical staff at each. In spite of limitations in funds and personnel valuable results have been secured in showing how to plant the Nebraska sand hills, in planting on the western National Forests, in the development of methods of cutting Douglas fir forests, in a study of the relation between forests and streamflow, and many other questions.

The field of forest experiment stations includes forest botany; forest distribution; forestation, from the production, collection, extraction, cleaning, testing and storage of seed, to nursery practise, direct seeding and field planting; silviculture; forest protection; utilization of products, such as naval stores and forage; forest management, or the regulation of the cut with its basis of data on volume, growth, and yield; the effect of forests on streamflow, erosion, and climate; and, underlying these, studies of the fundamental natural laws governing tree growth and the life histories of the individual species and types.

To meet present forestry needs, a program is outlined which includes ten forest experiment stations, each with a technical staff of from 6 to 12 men, and distributed, 5 in the East, 3 in the Rocky Mountains, and 2 on the Pacific Coast. Specifically, they would cover the Southern Pine belt in the Atlantic and Gulf States, the Lake States, the Northeast, including New England and New York, the Allegheny region, the Southern Appalachian Mountain region, the northern, central, and southern parts of the Rocky Mountain system, and the northern and southern parts of the Pacific Coast region.

THE U. S. PATENT OFFICE

When Commissioner Newton was in charge of the Patent Office in July, 1919, he testified before a committee of Congress to the effect that the situation in his bureau was deplorable and that it was in a worse condition at that time than at any other time since he had been in service. His service began in 1891. The present commissioner of patents in his report to the Congress points out that the degeneration has continued steadily since the testimony of Commissioner Newton was given. Between July, 1919, and June 30, 1921, the Patent Office lost 163 of its examiners. The report states that

> These men were scientifically trained and also members of the bar. They have been replaced by inexperienced men, fresh from college, without any knowledge of patent law and without legal training.
>
> During the time the Patent Office has been losing the 163 men aforesaid, the number of applica-

tions received in this office has increased by leaps and bounds. The number of applications for patents has increased 34 per cent. during the period under discussion, while the trade-mark applications increased eighty-five and a half per cent. In July, 1919, when Commissioner Newton testified, there were 18,000 patent applications awaiting action. There are now about 50,000 applications awaiting examination. It is further shown that a number of divisions are over 11 months behind in their work, and to illustrate the large turnover in the personnel there is cited one of the chemical divisions where five out of the nine examiners have been appointed in the last few months. At the close of the fiscal year, one of these had been in the office only 1 week, another 3 weeks, another 7 weeks and another 2 months. One out of every four examiners has resigned in 16 months and more than half have resigned in 32 months. Relief is, therefore, imperative.

Reference is made to the entrance salaries of the assistant examiners, who are a highly educated and picked corps of scientific men, who receive the same initial salary as clerks who perform routine duties in other branches of the government service. Note is made of the inadequacy of the salaries paid to these technical men as compared to their qualifications and the requirements of their position, showing the necessity of correcting the disparity of conditions.

The receipts of money for the fiscal year just closed increased from $2,615,297.33 of the previous fiscal year to $2,712,119.69, or almost $100,000. A net surplus of $284,342.93 was earned and if the bonus be subtracted therefrom, the surplus amounted to $71,743.73, making the total net surplus to date—that is, the excess of receipts over expenditures during the history of the Patent Office —$8,376,769.92.

SCIENTIFIC JOURNALS PUBLISHED BY THE GOVERNMENT

PRACTICALLY all the technical and scientific periodicals which the Government is issuing have been suspended. These include the *Journal of Agricultural Research* and the *Experiment Station Record,* issued by the Department of Agriculture.

The matter goes back two years or more to a time when Senator Smoot secured the adoption of a resolution terminating the issue within a specified period of all periodicals not authorized by the Congress. Hearings were held and assurance was given that the committee was not concerned with scientific journals, but was particularly interested in certain war-time periodicals which had sprung up. The time for action was extended once or twice, and, as the committee had failed to decide what should and what should not be printed, an item was inserted in the Sundry Civil Bill last March, extending the time to December 1, 1921, and providing that such publications as were not approved prior to that time should be discontinued.

Near the close of the last Congress, Senator Moses, the present chairman of the joint committee on printing, secured the passage of a measure in the Senate placing the matter of continuance or discontinuance in the hands of the joint committee on printing. The resolution went to the House in the closing days of the session, where it was amended by the House committee to provide for a further extension of time to March 1, 1922, in order that the committee might have further time for consideration. No action was taken on the resolution and the periodicials in question ceased publication with December 1. The latest proposal is not to give any further authorization for the continuance of any of them. Discussion of the matter will be found in the *Congressional Record* for December 7.

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE Toronto meeting of the American Society of Zoologists will convene on Wednesday, December 28, in the biological building of the University of Toronto. The sessions will continue until Friday night. The program of contributed papers numbers 109, the largest in the history of the society. The tentative program follows:

WEDNESDAY, DECEMBER 28

A.M.

Section A. Embryology, Cytology and Comparative Anatomy.

Section B. Genetics.

P.M.

Genetics.

Evening

Professor William Bateson's address before the American Association, followed by the Biological Smoker at Hart House. Members of all biological societies are invited to attend.

THURSDAY, DECEMBER 29

A.M.

Joint meeting with Ecological Society of America.

P.M.

Section A. Parasitology.

Section B. General and Comparative Physiology.

FRIDAY, DECEMBER 30

A.M.

Business session.
Section A. Parasitology.
Section B. Genetics.
Inspection of Exhibits.

P.M.

Symposium on Orthogenesis: L. J. Henderson, C. B. Lipman, M. F. Guyer, William Bateson, and H. F. Osborn, with discussions by Oscar Riddle, J. G. Fitzgerald and J. C. Merriam.

Evening

Annual Zoology Dinner, followed by address by William Bateson, "The Outlook in Genetics." Members of all biological societies are invited to attend.

W. C. ALLEE,
Secretary-Treasurer

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM BATESON, director of the John Innes Horticultural Institute, who will be present at the convocation week meeting at Toronto as the guest of the American Association for the Advancement of Science and the American Society of Zoologists, will give a public address on "The Evolutionary Faith and Modern Doubt." At the dinner of the Zoologists he will speak on "The Outlook in Genetics."

THE nomination of Dr. Walter B. Cannon, Harvard Medical School, to serve in the Medical Reserve Corps of the U. S. Army, with the rank of brigadier general, has been confirmed by the Congress.

HENRY HOWARD was elected president of the American Institute of Chemical Engineers at the convention held in Baltimore recently.

YANDELL HENDERSON, professor of applied physiology, graduate school, Yale University, has been elected a corresponding member of the Society of Physicians of Vienna.

SIR FRANK DYSON, astronomer royal, has been elected master of the Clockmakers' Company.

AT the inaugural meeting of the 168th session of the Royal Society of Arts held on November 2, the society's medal was presented to Sir Dugald Clerk, Sir Herbert Jackson, Sir Daniel Hall and Sir Oliver Lodge, for their Trueman Wood lectures. Medals were also presented to Mr. A. F. Baillie, Dr. W. Cramp, Mr. W. Raitt and Sir Charles H. Bedford for papers of chemical interest.

AT the meeting of the Chemical, Metallurgical and Mining Society of South Africa, held on October 15, the following gold medals were presented under the terms of the society's research endowment fund. For chemical research to Dr. James Moir; for metallurgical research to Dr. William Arthur Caldecott and Henry A. White; for mining research to John Innes.

DR. R. W. WOODWARD has resigned as physicist and chief of the section of mechanical metallurgy of the Bureau of Standards, Washington, D. C., to become chief metallurgist for the Whitney Manufacturing Company, Hartford, Conn.

PROFESSOR HENRY H. JEFFCOTT has recently been appointed successor to Dr. J. H. T. Tudsbery as secretary of the Institute of Civil Engineers, London.

PROFESSOR H. DOLD, of the Institute for Experimental Therapy in Frankfurt-on-Main, has been appointed to the charge of the sero-diagnostic department of the Emil von Behring Institute, under the supervision of Professor Uhlenhuth.

DR. F. E. KNOCH, superintendent of the United Oil Company, Florence, Colorado, and

Dr. S. K. Loy, chief chemist for the Rocky Mountain Division of the Standard Oil Company (Inc.), Casper, Wyoming, have accepted appointments as consulting chemists to the U. S. Bureau of Mines. They will assist the regular staff in the investigations now being carried on by the bureau with Colorado and Utah oil shales at its Boulder and Salt Lake stations.

James H. Mason Knox, Jr., associate in clinical pediatrics in the John Hopkins Medical School, has been granted a year's leave of absence to assume charge of child welfare work in Europe, under the Red Cross.

Gaichi Yamada, assistant professor of metallurgy at the Kyoto Imperial University of Kyoto, Japan, has been visiting the mills and smelters of the Great Lakes district in conclusion to a year's tour of the United States.

Dr. Cayetano Lopez, port inspector of Barcelona for the Spanish Bureau of Animal Industry, recently spent some time in Washington studying the organization and methods of the Bureau of Animal Industry of the United States Department of Agriculture with special reference to bacteriology and pathology. The Spanish Government contemplates the establishment of a laboratory in connection with the agricultural department for the study of animal diseases.

Professor Arthur de Jaczewski, director of the Institute of Mycology and Phytopathology at Petrograd and president of the Russian Mycological and Phytopathological Society, and Professor N. I. Vavilov, director of the Bureau of Applied Botany and Plant Breeding at Petrograd and editor-in-chief of the Russian Phytopathological Society, who came to the United States last August as the guests of the American Phytopathological Society, have completed their study trip through this country, and the following telegram has been received from them: "Leaving America we wish to send our American friends a last farewell and to thank you once more for the heartfelt and kind reception that made our trip in this country so pleasant and useful. We shall never forget the time spent with American scientists, and we hope that the connections established now in such a good way will be continued for the good of science and of our countries."

Dr. W. H. Parks, director of the research laboratory in the New York Board of Health, was the guest of the Wisconsin Branch of the Society of American Bacteriologists on December 2. In the afternoon he gave a lecture on "The Importance of the Schick Test in the Control of Diphtheria," which was open to the public. This was followed in the evening by a dinner and smoker at the University Club where Dr. Parks spoke informally about the work of his laboratory.

A course of ten lectures in applied anthropology will be given under the auspices of the Young Men's Christian Association and the Institute of Vocational Research of Washington, D. C., by Dr. Aleš Hrdlička of the U. S. National Museum.

Professor J. H. Walton, of the department of chemistry of the University of Wisconsin, lectured before the Milwaukee section of the American Chemical Society on November 18, on the subject "The Influence of Impurities on the Rate of Growth of Certain Crystals."

The second of the series of lectures on the "Progress of Science," under the auspices of the Society of Sigma Xi, Columbia Chapter, was held on December 15, by Dr. James Kendall, associate professor of chemistry, on "Recent progress in the science of chemistry."

A bust of the late Professor G. Galeotti is to be placed in the pathological institute at Naples.

Sir Douglas Fox, past president of the Institute of Civil Engineers and honorary member of the American Society of Civil Engineers, died in London on November 12, at the age of eighty-one years.

Mr. Edward Windsor Richards, a past president of the Institution of Mechanical Engineers and of the Iron and Steel Institute, died on November 12, at the age of ninety years.

Dr. Peter Thompson, professor of anatomy

at the University of Birmington and dean of the faculty of medicine, died recently at the age of fifty years.

PROFESSOR ERB, the neurologist, of Heidelberg, has died at the age of eighty-three years.

FOR the Toronto meeting of the American Association one of the attractions will be an exhibition of scientific apparatus and products held under the auspices of the association. It is hoped that firms and individual scientific men who have something new to exhibit will take advantage of this exhibition. The exhibition is in charge of an exhibition committee at Toronto, the chairman of this committee being Professor F. E. Burton, of the University of Toronto. Arrangements for entering exhibits are to be made by direct correspondence with Professor Burton.

THE American Anthropological Association will meet in conjunction with the American Folk-lore Society, the Maya Society and the Southwest Society at the Brooklyn Institute Museum from December 28 to 30 inclusive.

THE Geological Society of America will meet at Amherst, Mass., from December 28 to 30.

THE date for the Birmingham, Ala., meeting of the American Chemical Society has been placed from April 4 to 7, 1922.

THE American Petroleum Institute held its annual meeting at the Congress Hotel, Chicago, on December 6, 7 and 8.

THE tenth International Congress of Otology will be held in Paris next year. Dr. A. Hautant of Paris is secretary-general of the French committee.

UNIVERSITY AND EDUCATIONAL NEWS

THE Molteno Institute for Research in Parasitology, presented to the University of Cambridge by Mr. and Mrs. Percy A. Molteno, was formally opened on November 28.

DR. HENRY LAURENS, formerly assistant professor in biology in Yale College, has been promoted to be an associate professor of physiology and transferred from the department of zoology to the medical school faculty, where he has charge of the physiology. Associated with him is Dr. W. F. Hamilton, formerly instructor in physiology in the University of Texas. Dr. J. W. Buchanan (University of Chicago) has been appointed an instructor in biology in Yale College in Dr. Laurens's place.

DR. LANSING S. WELLS, until recently research chemist with the Barrett Company, Philadelphia, has accepted an appointment as assistant professor of organic and physical chemistry at the Montana State College, Bozeman, Mont.

DR. GLEN E. CULLEN has been elected associate professor of research medicine, and Dr. Goldschmidt, former lecturer in physiology in the School of Medicine, Cornell University, Ithaca, N. Y., has been elected assistant professor of physiology in the School of Medicine of the University of Pennsylvania. Dr. James Harold Austin was elected, last spring, professor of research medicine, to succeed Dr. Richard M. Pearce, who resigned to accept a position with the Rockefeller Foundation.

MR. HERBERT H. TANNER has been appointed assistant professor of chemistry in the University of Oregon.

JULIAN D. CARRINGTON, lately curator of biology at Cornell University, has resigned to become assistant professor of biology at the University of South Carolina.

APPOINTMENTS for the present year at the Case School of Applied Science include Dr. H. H. Lester, from the University of Washington and commercial work, to be assistant professor of physics, and Dr. J. J. Nassau, from Syracuse University, to be assistant professor of mathematics and astronomy.

DISCUSSION AND CORRESPONDENCE

IN ASSISTANCE OF THE ARCHIVES DE BIOLOGIE

IT will be remembered by the biological laboratories of about one hundred and fifty colleges and universities that last spring their attention was called to sets of lantern slides made from photomicrographs of Nereis egg preparations put up by Professor O. Van der Stricht, of the University of Ghent. The

negatives were loaned the writer by Professor T. Wingate Todd, director of the anatomical laboratory of Western Reserve University, where Professor Van der Stricht was a guest for some time during the war.

It was understood that profits from the sale of the slides should go for the benefit of the *Archives de Biologie*. of which Professors Van der Stricht and Brachet are editors. Concerning the Archives Professor Van der Stricht had written in July, 1919:

> . . . we need your valuable support, for we will lose half of our subscribers, the Germans and Austrians. . . . The Belgian government has not yet a penny available for laboratory work. In spite of all, we are very confident . . . and Belgium, with the support of the States, will live again.

The use of the cytological preparations for purposes of securing funds was, of course, not thought of by their maker, but seemed quite legitimate to us. This communication in SCIENCE is thus intended as an informal report to the considerable number of institutions who cooperated by their orders as to the outcome of the scheme.

Up to the present time two remittances have been sent, totalling $350. At the prevailing rate of exchange this allowed a realization of 4703 francs.

In the letters accompanying the remittances the liberty was taken of using the following wording, in part:

> You must accept this small sum as being the result of your own labor. Incidentally you may well feel that you have assisted instruction as given in numerous American institutions; for not only in courses dealing with embryology and heredity, but also in all introductory courses in general biology the phenomena of maturation, fertilization and cell division constitute fundamental information . . . much credit is due the institutions which purchased the lantern slides, for without their orders our little enterprise would have been a failure.

In acknowledgment Professor Van der Stricht said, in part:

> In agreement with my colleague, Dr. Brachet, we gratefully accept this amount which will be devoted to the publication of the *Archives de Biologie*. The cost of issuing this journal is, indeed, very great just now. Subscriptions do not cover it, so that we lose a great deal of money. Fortunately, my appeal in 1919 to the United States colleagues (for subscriptions) has been rather gratifyingly answered; many orders for sets came in, so that we were able to continue printing. Your . . . donations will help us very much for this purpose. Thus we owe our "Zoological Friends in America" an immeasurable debt of gratitude.

I would like to add that sets of these lantern slides may still be obtained, though we are not making them except on receipt of orders. They clearly illustrate twelve important steps in maturation, fertilization, and the first cleavage of the eggs of *Nereis limbata*. The price is $15 for the twelve slides, and the mutual agreement is that all receipts above actual expenses shall go for the assistance of Belgian science in the manner above indicated.

ROBERT A. BUDINGTON
SPEAR LABORATORY, OBERLIN COLLEGE,
OBERLIN, OHIO

THE VIBRATIONS OF A TUNING FORK

TO THE EDITOR OF SCIENCE: In a number of SCIENCE,[1] which has just come to our attention, Professor Charles K. Wead makes the following statement:

> In a recent article in a psychological journal the tuning fork is considered as composed of two bars each attached at one end to a solid block.

He then proceeds to describe Chladni's theory of the tuning fork to correct this "surprising" disclosure.

After reading Professor Wead's note we referred to our original paper.[2] In comparing vibrating bars and forks we write:

> The bar is, in fact, a fork straightened out; or, which is the same thing, the fork is a bar bent into the shape of a U. If we gradually bend a bar into a U, the two nodes approach the base. When the bending is complete we have a single node at the base—*i.e.*, a fork.

Our point, of course, is that the tuning fork *is* essentially a bar—a single vibrating system.

[1] Nov. 11, 1921, 468–9.

[2] *Psychological Bulletin*, September, 1918, 293 f.

Nowhere do we regard the fork as made up of two bars attached to a solid base. Since the question of how we may best regard a vibrating tuning fork has been raised, we have turned once more to Rayleigh.[3] After a mathematical discussion he writes:

> . . . These laws find an important application in the case of tuning forks, whose prongs vibrate as rods, fixed at the ends where they join the stalk, and free at the other ends.

Also Edwin H. Barton,[4] a pupil of Lord Rayleigh, writes:

> The behavior of the U-shaped bars just dealt with approximates to that of tuning forks. But the vibration of tuning forks is usually further complicated by the presence of an additional block at the center of the bend and the stem attached thereto. Indeed, it may be a nearer approximation to regard each prong as a straight bar fixed at the end near the stem and free at the other end.

It appears, then, that this "crude" manner of considering a tuning fork, which has been wrongly attributed to us, is actually accepted by no less an authority than Rayleigh and his pupil, Barton.

Professor Wead's interpretation of our view is probably based upon our statement that the fork has a single node at the base. This, of course, is only an approximation.

An alternative explanation, according to Professor F. R. Watson, of this university, is to consider the fork as a single vibrating system in which the center of mass tends to remain fixed in position. As the tines of the fork are bending outward, the center of mass tends to lower, so that the stem and block of the fork rise a bit so as to keep the position of the center of mass unchanged. As the tines return inward, the center of mass tends to rise, so that the stem of the fork lowers. The stem of the fork thus executes minute up and down movements.

PAUL THOMAS YOUNG
UNIVERSITY OF ILLINOIS

AN ANECDOTE CONCERNING DR. FIELD

I HAVE read with great interest Dr. Ward's sketch of the life and work of the late Herbert Haviland Field. It, however, omits any mention of his appreciation of humor, and perhaps I may be allowed to tell of one of his practical jokes which, to me at least, was most amusing.

The late Henry B. Pollard had just completed his work on the anatomy of *Polypterus* and had gone from Wiedersheim's laboratory for lunch. I came in a little later, started my studies, and then Pollard came in, and in a moment I realized what "Uncle Toby" meant when he referred to the profanity of "our army in Flanders." Pollard turned to me, holding up a drawing of the cranial nerves of that fish which was almost completely covered with hæmatoxylin, and demanded who did it. I knew nothing of it and so replied. Pollard said he would call the attention of the professor (Wiedersheim) to it and at once left the room. As he went out of one door of the laboratory, the door from the anatomical museum opened and in came Field, who removed the damaged drawing from Pollard's table, opened a drawer and took out another drawing, and again left the room. Pollard almost immediately returned, bringing the professor with him. "Look at that!" said Pollard. "Was ist los?" asked Wiedersheim, and then Pollard looked and saw his drawing in perfect condition. I never saw such an expression of complete inability to comprehend as that on Pollard's face. He was utterly without words, The explanation of the whole was that Field had found the tracing paper which Pollard had used, had rapidly redrawn on another sheet the nerves and skull of *Polypterus,* had deluged it with staining fluid and left it for Pollard to find, waiting in the museum to hear what the English youth would and could say.

S.

TWO RETROSPECTIVE FEATURES OF THE TORONTO MEETING

THE membership list in the last volume of the Summarized Proceedings, recently published, shows that the Association has a considerable number of members living in coun-

[3] "Theory of Sound," 1894, Vol. I., 274.
[4] "A Text-Book on Sound," 1908, 298.

tries outside of the United States. Naturally, from the contiguity of Canada, the largest number of those foreign members reside there, the list showing 230 names of residents of Canada. This number is larger than the total membership of the Royal Society of Canada, which, however, limits its membership. But it is small in comparison with the total membership of the Association, although not insignificant in view of the fact that no meetings have been held in Canada since the last Toronto meeting thirty-two years ago. After the meeting of 1889, the next following list contained 85 names of members and fellows resident in Canada. While only seven of these 85 persons now survive as members, the present Canadian membership of 230 indicates that accessions have been increasing, and doubtless there will be further increases as a result of the meeting about to be held.

The place of the meeting is also a reminder that the Geological Society, at the time of the last meeting in Toronto, took a step toward organization as an independent body, which was the beginning of a movement that has eventually contributed to the remarkable growth of the Association. The recently issued volume shows that in addition to the large membership of nearly 12,000, there are now 93 affiliated and associated societies, most of which have been organized since 1889.

A. F. Hunter

Normal School Building,
Toronto, Nov. 15, 1921

SCIENTIFIC BOOKS

The Life of the Pleistocene or Glacial Period. By Frank Collins Baker. University of Illinois Bulletin, vol. XVII., No. 41; June 7, 1920, iii, 476 pp. 8, pl. 1–57. Urbana, Illinois.

This portly volume is divided into two parts, the first including beside a historical summary of preceding researches an account of the postglacial geology and life of the Chicago area, followed by a résumé of our present knowledge of the postglacial life of the entire glaciated region of the United States and Canada. Each locality investigated is taken up separately, its stratigraphy and fossil content described and listed, and at the end of each chapter the collected data are summarized.

In the second part the life of the interglacial intervals is discussed and the species of plants and animals listed from data furnished by an indefatigable search of all available literature.

The difficulties attending the reduction to a common nomenclature of the records extending over many years, can easily be understood and the author frankly acknowledges that in some cases his judgment may have been at fault, but such instances do not materially affect the general conclusions and are inevitable in any such bringing together of scattered data of varying degrees of authenticity. The volume concludes with a bibliography of forty-five pages, covering the literature from 1846 to the date of publication and an ample index. Among the plates are interesting maps showing the fluctuations of the geographical features of the Chicago area and the region about Toronto, as well as the extensions at numerous periods of the continental ice sheet. It would have added to the convenience of those who use the volume if legends had been added to the plates, obviating the necessity of turning back in each instance to the printed explanation.

Much of the work, and presumably of the most carefully observed and valuable part of it, is the result of field work prosecuted by the author. The labor involved in the search for and correlation of the data in the literature was evidently prodigious, and reflects credit on the industry and patience of the author. His work in bringing together in orderly shape the data bearing on his subject will be a boon to all later students of the American Pleistocene. We may be permitted to regret the instrusion in a scientific work of a few of the "simplified spelling" futilities; we really *ot* not to imply that *thot* renders either the sound or the meaning of the word *thought*.

Wm. H. Dall

SPECIAL ARTICLES

THE EGG-LAYING HABITS OF MEGARHYSSA (THALESSA)

DURING the summer of 1921 I had frequent occasion to watch the females of the beautiful large Ichneumonid *Megarhyssa* (formerly *Thalessa*) in the act of ovipositing into the trunk of a decaying maple tree at Mendham, N. J. In looking over the literature on the subject, I find that this process, though often described and commented upon, does not seem to have been fully elucidated so far. There are at least two facts that have escaped attention of observers, namely first, that the ovipositor is always brought into a position at right angle to the bark *directly behind the thorax of the insect* and is held here in position by the hind coxae, allowing only upward and downward movements but no lateral excursions. It is only under this condition that one may correctly say that the insect "makes a derrick out of her body" (Comstock). The second point is, that the remarkable extensile membranous sac or disc into which the ovipositor enters with its basal part to allow of its being temporarily shortened, is not only formed twice, at the beginning and at the end of the process, but at the beginning *receives also the sheaths into its interior,* which are freed when the membrane collapses, as two separate loops, while at the end of the process, when the membranous sac forms again, the loops of the sheaths do not re-enter it, making it possible that one can tell whether the insect is just beginning or just ending operations.

It appears that the extensile membranous sac has been seen first and correctly interpreted by J. Quay,[1] who, however, does not mention the loops formed by the sheaths. The most complete and accurate account is given by C. V. Riley,[2] who describes the loops formed by the sheaths, which, as he correctly stated, do not enter the wood. But Riley is in error in his statement that the sheaths "have not followed the ovipositor within the membrane"; in fact they do so at the beginning of the process. According to Riley the sheaths make "a larger and larger loop *on one side of the body*[3] or even a valve on each side," and he figures the ovipositing insect with ovipositor and sheaths on one side of the body which is quite impossible. In the same figure, otherwise excellent, the ovipositor is drawn at a certain distance behind the end of the thorax, while, as I have stated above, it is held by the hind coxæ. Riley criticizes the previous illustrations (Blanchard, Wood), which figure *Thalessa* (*Rhyssa*) as ovipositing into insect larvæ which she never does.

More recently, Comstock[4] gives an illustration possibly adapted from Riley as it figures almost exactly the same stage in the egg-laying process, and especially as it continues both Riley's errors in figuring the ovipositor at a certain distance behind the thorax, and on one side of the body. The wings are drawn as if held vertically; the antennæ held farther upward than in Riley's picture. The vertical position of the wings is preserved in Kellogg's and Lutz's figures. Kellogg's figure[5] is almost identical with that (presumably older one) of Comstock but apparently redrawn as to details; the error of drawing the sheaths both on one side of the body has here been eliminated. The figure in The New International Encyclopaedia (2d edit., 1915, article "Ichneumon fly"), is adapted from Riley; the antennæ, however, are here drawn as if directed vertically upward—perhaps to save space. It should be noted that the egg-laying insect holds the antennaæ forward and often downward, touching the bark. This figure also shows both Riley's errors which I have commented upon. A new illustration is given in Lutz's "Field Book of Insects" (1918; Pl. LXXXVIII., p. 413); this illustration was, as Dr. Lutz tells me, not drawn from nature but combined from illustrations and a specimen they had. This picture is the first one in a long time to show a different stage in the process than that

1 *American Entomologist,* Sept., 1880, Vol. III., p. 219.

2 "Insect Life," Vol. I., 1889, p. 168 ff.

3 Italics mine.

4 "Manual for the Study of Insects," 13th edit., 1915, p. 623, Fig. 749.

5 "Insects," 1905, Fig. 682.

figured by Riley, and the membranous disk is shown correctly with the sheaths inside, corresponding to the beginning of the boring process. But the position of the abdomen is impossible; indeed at this stage, when the disk is formed, the abdomen is held not only vertically but even bent forward to some extent above the thorax; and at no time during the whole process is the ovipositor inserted as far behind the insect as drawn by Lutz. Like Comstock, Lutz shows the wings in a vertical position and the antennæ are held obliquely upward which is possible but not characteristic. Mention should be made that Riley too, already gave a picture, undoubtedly from a preserved specimen, of the extended membrane, the two sheaths just leaving it, as would be the case as soon as the membrane begins to collapse. This illustration shows very well how the ovipositor at the beginning of the process is held in a vertical direction by being sunk into a ventral furrow of the abdomen, which renders its basal portion quite invisible.

It becomes a matter of interest that, of many authors commenting on such a familiar insect as our large, long-tailed ichneumon fly, and on its oviposition, only comparatively few have watched the process long enough to verify its details, and that, in fact, some of these details have never been clearly established though *Megarhyssa* is common in many localities. Does not this indicate that we have been neglecting the ecological for the systematic aspect of entomology?

WERNER MARCHAND

MENDHAM, N. J.

A CONDENSATION PUMP

CONDENSATION pumps of the following particular type have been used in our work for a number of years and the design seems to possess sufficient advantages over others in both simplicity and compactness to merit this note.

The method of operation of this pump, in which the exhausting process is accomplished in two stages, will be made clear by reference to the cut. In the initial or "rough" stage, *A*, the mercury vapor is ejected at relatively high pressure from a small nozzle into a long narrow throat. The nozzle opening is made sufficiently small that the pressure of the vapor

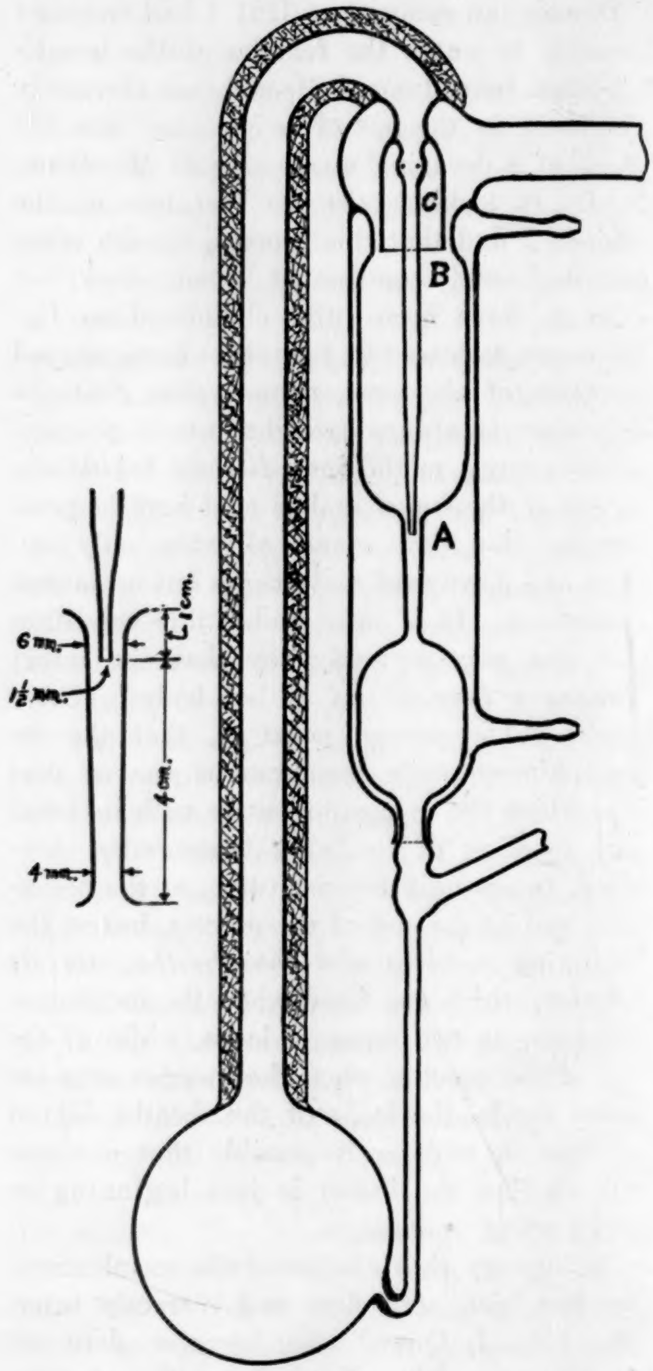

FIG. 1

in the boiler, instead of being practically limited to 2 or 3 millimeters, as in the case of the ordinary vapor pump, may attain a value of 75 millimeters or more depending upon the heating. The efficacy of this arrangement was first pointed out by Stimpson.[1] The evac-

[1] *Washington Acad. Sci. J.*, 7, pp. 477–482, Sept. 19, 1917.

uation is completed through the fine stage, B. In this unit a portion of the high-pressure vapor from the central tube is allowed to expand to a low pressure through one or two small openings into the inverted cup, C. This vapor then escapes freely into the large water jacketed tube and gives the conditions essential for high-speed exhaustion.

It has found that the high-pressure stage operating alone, without assistance from the low-pressure unit, will produce a high vacuum. The speed of the high-pressure unit by itself, however, is very much less than that of the combination, which possesses a speed comparable with that of a single stage pump of equivalent proportions.

The advantage of the combined units, of course, lies in the fact that such a pump will function in a perfectly satisfactory fashion with a very ordinary fore-vacuum. A mechanical pump capable of reducing the pressure to 2 or 3 millimeters is satisfactory, or even a water aspirator which will give a vacuum of 20 millimeters can be used if nothing better is available.

With regard to the construction of the pump perhaps a little may be said. Glass possessing a low coefficient of expansion such as Pyrex or Corning G702P glass must be used in making it, as otherwise one will almost certainly experience the rather annoying inconvenience of having the boiler crack upon application of the heat. The size of the pump can, of course, be varied considerably, but the general proportions of the parts given in the drawing are found to be very satisfactory. In the pump from which the drawing was made the mecury boiler has a diameter of 90 millimeters and the other dimensions were reduced proportionately. The dimensions of the jet and throat which have been found to work well are indicated in the enlarged sketch of this part. The diameters given apply to the tube openings. The thickness of the nozzle wall should be as thin as is consistent with reasonable strength. The two small openings which serve to furnish a supply of vapor to the upper unit are about the size of ordinary pin holes and are located on opposite sides of a small enlargement in the central tube. The joint between the lower end of the water jacket and the body of the pump is made water tight by binding it tightly with strips of thin rubber. There is some advantage in having a slight constriction where the mercury return tube is sealed to the boiler as the presence of a constriction here tends to preserve the equilibrium of the mercury in the return tube.

The mercury in the boiler should be about 2 centimeters in depth at the center and ordinarily, with a properly adjusted flame, it will evaporate without serious bumping even at the higher pressures. The height of the mercury column in the return tube indicates the vapor pressure in the boiler and the pressure required for satisfactory pumping depends entirely upon the fore-vacuum. There is no harm, however, in running the vapor pressure up as high as the length of the return tube will permit if this be necessary to enable the pump to function.

E. H. KURTH
PALMER PHYSICAL LABORATORY,
PRINCETON, N. J.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. E. Coates, Chairman
T. J. Bryan, Secretary

The testing and grading of food gelatins: CLARKE E. DAVIS AND EARL T. OAKES. Loeb's recent work on gelatin is briefly discussed and Bancroft's objections to Loeb's conclusions on the basis of the insolubility of gelatin as based on surface tension measurements by Slobeki are shown to be in error. Methods for determining gel strength and viscosity are given and the effects of various factors affecting these properties are discussed with data. Data on the causes for discrepancies between grading gelatins by gel strength tests and by viscosity measurements are given. Gelatins submitted by the manufacturers as examples in which gel strength does not parallel viscosity are shown to be classified alike by gel strength and viscosity measurements under the methods described.

Active chlorine as a germicide for milk and

milk products: HARRISON HALE AND WILLIAM L. BLEECKER. The increasing and satisfactory use of active chlorine as a germicide for water suggests the possibility of its use for milk and milk products. Numerous bacteriological tests show a reduction in number of bacteria in general proportional to the amount of active chlorine present. Chlorine water, sodium hypochlorite and calcium hypochlorite solutions were used on milk and ice cream in dilutions varying from 1 part of active chlorine to 1000 parts of milk to 1 part to 100,000. Chlorine water in 45 minutes produces practically the same results that sodium hypochlorite does in 1½ hours and calcium hypochlorite in 19 hours.

The inadequacy of analytical data: H. E. BARNARD.

The chemistry of leavening agents: CLARK E. DAVIS AND D. J. MAVEETY.

Availability of salts in soils as indicated by soil colloids: N. E. GORDON. Iron, alumina and silica gels were prepared in the purest possible condition and shaken with various salt solutions until equilibrium was established. The maximum adsorption was determined. Then by a series of washings it was found in what way and to what extent the adsorbed salt became available for plant food. Furthermore, a series of experiments showed that the hydrogen-ion concentration plays a very important rôle in the availability of salts which are held by soil colloids.

The effect of pectin, acid and sugar on the character of gels: C. A. PETERS AND R. K. STRATFORD. Pectin extracted from apple pumace by water was used and a standardized method for making gels in 10 c.c. portions was developed. Acidity of 0.3 per cent. was necessary for gelation and acid above 0.3 per cent. did not increase the stiffness of gels. As the per cent. of pectin was increased the amount of sugar had to be increased to make the stiffest gel; with a certain per cent. of pectin less sugar makes a softer gel, an increase of sugar makes a stiffer gel while a further increase of sugar makes a gel less stiff. The character of the gel depends upon the hydrolysis of both the sugar and pectin.

Nutritive studies of the Georgia velvet bean, Stizolobium Deeringianum. III. Supplementary relationship of whole and skimmed milk to the hulled seed and the whole plant: J. W. READ AND BARNETT SURE. An earlier paper[1] in this series of studies on the nutritive value of the Georgia velvet bean showed that the raw bean is injurious to rats. If the ration is supplemented with a liberal supply of whole milk, rats grew at a rate even more rapid than normal, and three generations were successfully reared on this diet. Inasmuch as previous work had shown the velvet bean to be quite rich in the fat-soluble vitamine, experiments employing skimmed milk instead of whole milk and replacing the dextrin by starch were tried, but rearing of the young in two cases was not successful. In the case of the whole plant, however, a healthy and vigorous third generation was secured on such a simple and poorly constituted diet as that composed of 40 per dent. velvet bean hay (ground whole plant), 60 per cent. starch, and a liberal supply of skimmed milk.

[1] "Biological Analysis of the Seed of the Georgia Velvet Bean, *Stizolobium Deeringianum*," *Jour. Agr. Res.*, Vol. XXII., No. 1, pp. 5–18.

Nutritive value of the Georgia velvet bean (Stizilobium Deeringianum). (a) Supplementary relationship of leaf and the hulls of seed. (b) Nutritive value of the whole plant: BARNETT SURE AND J. W. READ. Our previous work[2] on the nutritive value of the Georgia velvet bean showed the seed to be abundant in the fat-soluble vitamine, but deficient in protein, salts, and the water-soluble vitamine. In this study we have found the leaf to be abundant in the water soluble and an efficient carrier of salts. The hulls, however, possessed no supplementary value to the seed, and they interfered with the utilization of the fat-soluble vitamine in the seed, as did also the velvet bean hay. Autoclaving the hulls for two hours at 15 pounds pressure did not change their disturbing effect. The data secured suggest that the interference with the utilization of the fat-soluble vitamine may possibly be due to indigestible celluloses.

Calcium chloride as a mineral supplement in the ration. (Preliminary report): J. W. READ AND BARNETT SURE. The literature contains the results of experiments conducted by several investigators within the last eight or ten years on the benefits derived from the addition of small quantities of calcium chloride to the ration. We considered it of possible value to check up on some of the results which have been reported, and have in progress certain experiments with rats, in which cotton seed meal constitutes 35 and 50 per cent. of the two basal rations which receive calcium chloride additions varying from 0.60 to 16.00 grams of the tetrahydrate salt per kilogram of ration. The rations receiving calcium chloride are compared to the controls free from salt additions, and to rations receiv-

[2] *Jour. Agr. Res.*, XXI., No. 9.

ing sodium chloride and calcium carbonate. Our results to date show rather remarkable responses to small amounts of calcium chloride, even as low as 0.6 of a gram to a kilogram of ration proves to be as effective as any of the higher additions of this salt. At this time, however, our experiments have not been in progress long enough to permit any definite conclusions, but they are being continued and will be reported later.

Sugar beets in Louisiana: C. E. COATES AND A. F. KIDDER. A long series of results show that it is possible to grow sugar beets of high sucrose and high purity in Louisiana and to obtain heavy yields. This is probably true for the South in general. The best results are obtained by late spring planting. The yields average 18 tons per acre; the purities about 85.0 and the sucrose 14.0. The essential feature is the necessity for obtaining good beet seed which breed true to type. Seed grown in the United States today fulfill these requirements.

Causes of hominy black. EDWARD F. KOHMAN.

The volatile acids and the volatile oxidizable substances of cream and experimental butter: L. W. FERRIS. In collaboration with Dr. H. W. REDFIELD AND W. R. NORTH. There has been found a noticeable difference between the amount of volatile acids found by distillation without saponification in butter made from sweet cream and the amount found in butter made from sour cream, the acidity of which had been reduced before pasteurization. The amount of volatile oxidizable substances was high and the lactose very low on the samples of butter made from cream which contained the higher numbers of lactose-splitting yeasts.

Some determinations on the soluble nitrogen compounds of cream and butter: L. W. FERRIS. The paper gives some of the results obtained in connection with an investigation of cream and butter conducted by Dr. H. W. Redfield and continued by the author. The report shows the relation of amino nitrogen and ammonia to total nitrogen and the relation of the nitrogen not precipitated by phosphotungstic acid to total nitrogen in cream and in butter when fresh and after being held under different conditions of storage. The greatest per cent. of such nitrogen, when the butter was fresh, and also the greatest increase during storage, was found in butter made from cream which had been allowed to sour before being pasteurized.

A method for the determination of amino nitrogen and ammonia in cream and butter: L. W. FERRIS. Picric acid and acetic acid are used to separate the protein and higher complex substances from the lower degradation products. The amount of nitrogen in the filtrate reacting with nitrous acid in Van Slyke's amino acid apparatus is determined. The filtrate can be held for some time without change in the amount of reacting nitrogen, and hydrolysis of the proteins during analysis is reduced to a minimum. It is found that there is a correlation between the ratio of the amino and ammonia nitrogen to the total nitrogen, and the quality of the sample.

The viscosity of natural and "remade milk." Food control laboratory: OSCAR L. EVENSON AND LESLIE W. FERRIS. The relation of viscosity to total solids is shown by means of the expression: $\frac{v-1}{\text{T. S.}}$, in which

$$v = \frac{\text{Time of flow of milk} \times \text{sp. gr. of milk}}{\text{Time of flow of water} \times \text{sp. gr. of water}}.$$

T. S. equals total solids. For a given number of samples, the values for $(v-1)/\text{T. S.}$ for natural milk varies from 5.68 to 7.18 and for remade milk from 6.37 to 12.60 at 25° C. The viscosity of milk as determined is, to a certain extent, dependent upon the temperature at which the milk has been held. Homogenizing at a high pressure increases the viscosity while emulsifying has little or no effect.

Composition basis for considering the water requirements of plants: H. A. NOYES. Higher moisture contents in orchard soils were found to occur on those plots where increased bacterial activities resulting from aeration of the soil had increased plant growth and markedly changed the analyses of the plants. As the result of the field work, given above, controlled greenhouse investigations were undertaken with different fertilizer treatments to study variations in analysis as related to changes in the water requirement of plants. In one set of experiments the water requirement (per unit of dry matter) decreased from 1,785 to 1,215 with a variation of 15 per cent. in the nitrogen content and 23 per cent. in the ash content of plants grown under different fertilizer treatments. A second set of experiments on a different soil and with a different crop showed a variation in water requirement of from 37.9 to 16.1 (per unit green weight) with a variation of 74 per cent. nitrogen content, 176 per cent. in phosphorus content of ash and 66 per cent. in the ash content of plants grown under different fertilizer treatments. The hypothesis adopted on the basis of these results is *that when a soil that will respond to fertilizer treatment* (*direct or indirect*) *is fertilized the plants growing in that*

soil are able to make their growth (approach normal) on less moisture and analyze differently than they otherwise would.

DIVISION OF DYE CHEMISTRY

A. B. Davis, Chairman
R. Norris Shreve, Secretary

The dye situation in Canada: W. F. Prescott.

Contribution to the chemistry of cyan-xanthen and cyan-acridinium: George Heyl. In the course of researches undertaken with a view of introducing into the acridinium molecule other groups to render the dye more toxic toward certain pathogenic organisms, it was found that a number of new dyes can be produced, heretofore not recorded. The development of these new dyes is accompanied by structural formulae and notes on the laboratory technique used. The biological value of the cyan dyes is not discussed, as the biological experiments are as yet incomplete.

Lakes from phenetidin: Dr. J. C. Schmidt. Phenetidin and derivatives when diazotized and coupled with beta naphthol or R salt form colors that range in shade from an orange to scarlet and to deep maroon. Some of these pigments are soluble, others insoluble in oils. These colors are remarkable for fastness to light and brilliancy, rivalling those produced from alizarine. Their qualities make them valuable for the manufacture of lakes for printing ink, and painting purposes, varnish stains, coloring waxes and paraffin also for printing textiles.

The synthesis of anthraquinone from phthalic anhydride and benzene: E. R. Harding. The Friedel Crafts reaction for the preparation of ortho benzoyl benzoic acid was studied extensively. Phthalic anhydride reacts with benzene and aluminum chloride to give an unstable intermediate compound which is easily decomposed to give a salt of benzoyl benzoic acid. This acid is readily converted to anthraquinone by heating with sulfuric acid. The yields throughout are good. The process is commercially attractive because the raw materials are abundant and comparatively low priced. Anthraquinone produced from anthracene so far has been expensive on account of the cost of anthracene, the removal of which from tar leaves a pitch of low value.

A direct reading spectrophotometer for measuring the transmissivity of liquids: Irwin G. Priest. This instrument has been designed to provide means for *rapid* and convenient as well as accurate work, particularly in the technologic examination of dye solutions and oils. It consists essentially of a combination of a constant deviation wave-length spectrometer and the author's "exponential" or "variation of thickness" photometer. Wave-length and transmissive index ("extinction coefficient") are both read *directly* from the instrument scales without any computation. A model instrument constructed in the Bureau of Standards Instrument Shop was exhibited at the Chemical Exposition Sept. 12–17, 1921. The instrument will be fully described in a forthcoming Bureau of Standards publication to which reference should be made for details. Interested persons may have their names placed on the mailing list for this paper by addressing the Bureau of Standards, Div. IV, Sec. 3, Washington, D. C.

Naphthalene sulphonic acids. IV. *The solubilities of some amino salts of naphthalene sulphonic acids:* H. Wales. Solubilities of the salts of alpha and beta naphthylamine with some naphthalene sulphonic acids have been determined between 25° and 98° C. Allotropic changes are indicated for two of the salts and an interesting relation between the solubility and structure of a series of isomers is shown.

The preparation of alpha gamma quinolines. I. *2, 4 dimethyl, 6 ethoxy quinoline: An improved method for its preparation and a study of the condensation:* S. Palkin and M. Harris. A study has been made of the conditions affecting the yield and quality of 2, 4 dimethyl, 6 ethoxy quinoline as prepared by the Beyer (Pfitzinger) synthesis for alpha gamma quinolines. Tolerance toward water and temperature variation and effect of oxidation in the synthesis; also relative effectiveness of purification reactions introduced by Mikeska for the recovery of pure base have been investigated. Boiling range curves (at 30 mm.) for the base at different stages of purification have been worked out. One of the principal difficulties incident to the recovery of the base from the reaction mixture, has been overcome by the application of a steam treatment rendering possible the elimination of tedious extractions or steam distillations. An improved process (depending on the Beyer-Pfitzinger synthesis) for 2, 4 dimethyl, 6 ethoxy quinoline, is described, which is much simpler of manipulation, requires less time to carry out, is adaptable to larger scale operation, and yields 10 to 15 per cent. more pure base than by the former method.

Charles L. Parsons,
Secretary